

### Product Overview

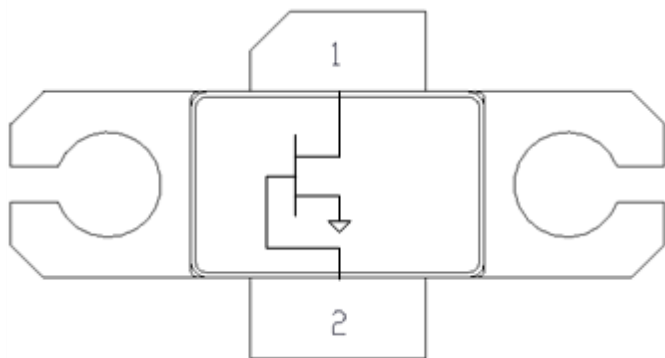
The Qorvo TGF2929-FL is a 107 W (P<sub>3dB</sub>) discrete GaN on SiC HEMT which operates from DC to 3.5 GHz. The device features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions. This optimization can potentially lower system costs in terms of fewer amplifier line-ups and lower thermal management costs.

Lead-free and ROHS compliant.

Evaluation boards are available upon request.



### Functional Block Diagram



### Key Features

- Frequency: DC to 3.5 GHz
  - Output Power (P<sub>3dB</sub>)<sup>1</sup>: 107 W
  - Linear Gain<sup>1</sup>: 17 dB
  - Typical DEff<sub>3dB</sub><sup>1</sup>: 60.8%
  - Operating Voltage: 28 V
  - Low thermal resistance package
  - Pulse capable
- Note 1: @ 3.5 GHz

### Applications

- Military radar
- Civilian radar
- Professional and military radio communications
- Test instrumentation
- Wideband or narrowband amplifiers
- Jammers

Part No.	Description
TGF2929-FL	DC–3.5 GHz RF Power Transistor
TGF2929-FLEVB01	3.1 – 3.5 GHz Evaluation Board



# TGF2929-FL

## 100W, 28V, DC–3.5 GHz, GaN RF Power Transistor

### Absolute Maximum Ratings<sup>1</sup>

Parameter	Rating	Units
Breakdown Voltage, $BV_{DG}$	+145	V
Gate Voltage Range, $V_G$	-7 to +2	V
Drain Current	12	A
Gate Current Range, $I_G$	See page 4.	mA
Power Dissipation, 20% DC 500 $\mu$ S PW, $P_{DISS}$ , $T = 85^\circ\text{C}$	144	W
RF Input Power, CW, $T = 25^\circ\text{C}$	+39.8	dBm
Mounting Temperature (30 Seconds)	320	$^\circ\text{C}$
Storage Temperature	-65 to +150	$^\circ\text{C}$

Notes:

1. Operation of this device outside the parameter ranges given above may cause permanent damage.

### Recommended Operating Conditions<sup>1</sup>

Parameter	Min	Typ	Max	Units
Operating Temp. Range	-40	+25	+85	$^\circ\text{C}$
Drain Voltage Range, $V_D$	+12	+28	+50	V
Drain Bias Current, $I_{DQ}$	-	260	-	mA
Peak Drain Current, $I_D^3$	-	7.2	-	A
Gate Voltage, $V_G^4$	-	-2.7	-	V
Power Dissipation, CW ( $P_D$ ) <sup>2</sup>	-	-	82	W
Power Dissipation, Pulsed ( $P_D$ ) <sup>2, 3</sup>	-	-	140	W

Notes:

1. Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.
2. Package base at  $85^\circ\text{C}$
3. Pulse Width = 100  $\mu$ S, Duty Cycle = 20%
4. To be adjusted to desired  $I_{DQ}$

### Pulsed Characterization – Load-Pull Performance – Power Tuned<sup>1</sup>

Parameters	Typical Values				Unit
	1.0	2.0	3.0	3.5	
Frequency, F	1.0	2.0	3.0	3.5	GHz
Linear Gain, $G_{LIN}$	21.2	16.7	15.6	15.8	dB
Output Power at 3dB compression point, $P_{3dB}$	100	132	120	107	W
Drain Efficiency at 3dB compression point, $DEff_{3dB}$	61.0	60.4	57.6	54.4	%
Gain at 3dB compression point	18.2	13.7	12.6	12.8	dB

Notes:

1. Test conditions unless otherwise noted:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $Temp = +25^\circ\text{C}$

### Pulsed Characterization – Load-Pull Performance – Efficiency Tuned<sup>1</sup>

Parameters	Typical Values				Unit
	1.0	2.0	3.0	3.5	
Frequency, F	1.0	2.0	3.0	3.5	GHz
Linear Gain, $G_{LIN}$	22.3	17.2	16.9	17.0	dB
Output Power at 3dB compression point, $P_{3dB}$	47.8	50.1	49.8	48.9	W
Drain Efficiency at 3dB compression point, $DEff_{3dB}$	76.6	66.9	68.3	60.8	%
Gain at 3dB compression point, $G_{3dB}$	19.3	14.2	13.9	14.0	dB

Notes:

1. Test conditions unless otherwise noted:  $V_D = +28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $Temp = +25^\circ\text{C}$



## RF Characterization – 3.1 – 3.5 GHz EVB Performance At 3.3 GHz<sup>1</sup>

Parameter	Min	Typ	Max	Units
Linear Gain, $G_{LIN}$	–	15.0	–	dB
Output Power at 3dB compression point, $P_{3dB}$	–	106	–	W
Power-Added Efficiency at 3dB compression point, $PAE_{3dB}$	–	51.3	–	%
Gain at 3dB compression point, $G_{3dB}$	–	12.0	–	dB

Notes:

1.  $V_D = +28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ , Temp = +25 °C, 100  $\mu\text{S}$ , 20%

## RF Characterization – Mismatch Ruggedness at 3.5 GHz<sup>1</sup>

Symbol	Parameter	dB Compression	Typical
VSWR	Impedance Mismatch Ruggedness	3	10:1

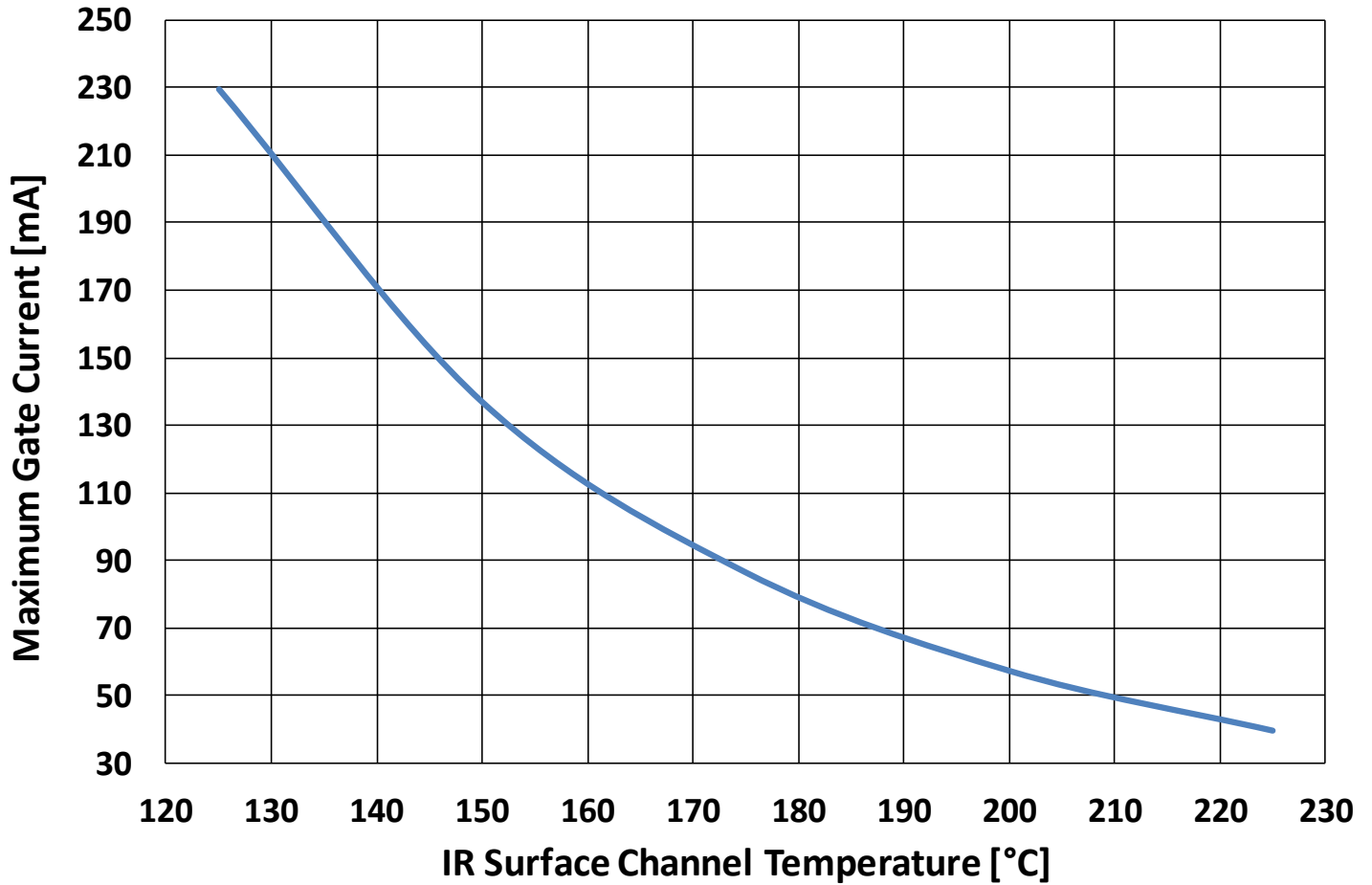
Notes:

1. Test conditions unless otherwise noted:  $T_A = 25\text{ °C}$ ,  $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ , 100  $\mu\text{S}$  PW, 20% DC
2. Driving input power is determined at pulsed compression under matched condition at EVB output connector.

Maximum Gate Current

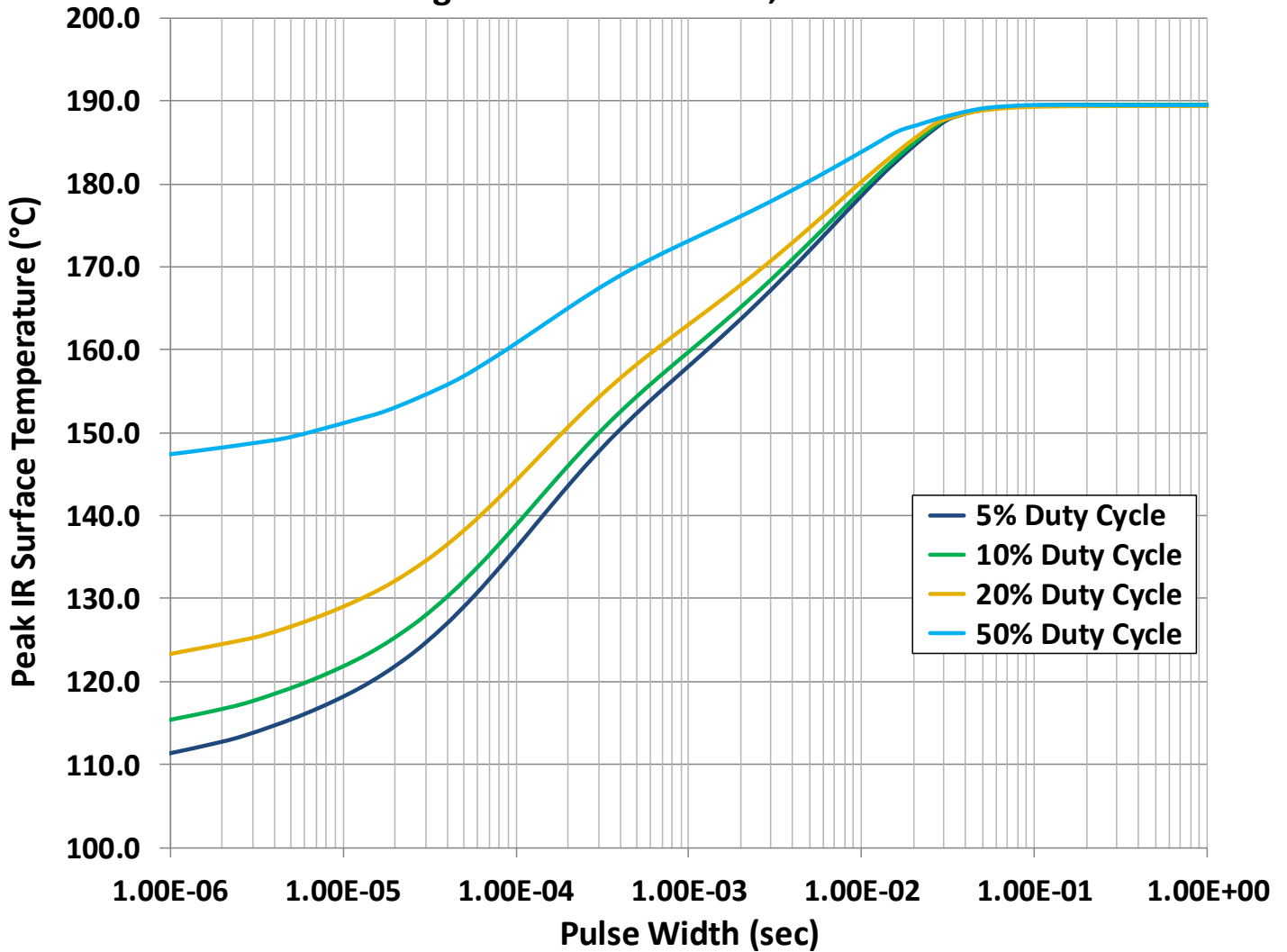
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**Maximum Gate Current Vs. IR Surface Temperature**



## Thermal and Reliability Information – Pulsed

**Peak IR Surface Temperature**  
 Package base fixed at 85°C, Pdiss = 100 W



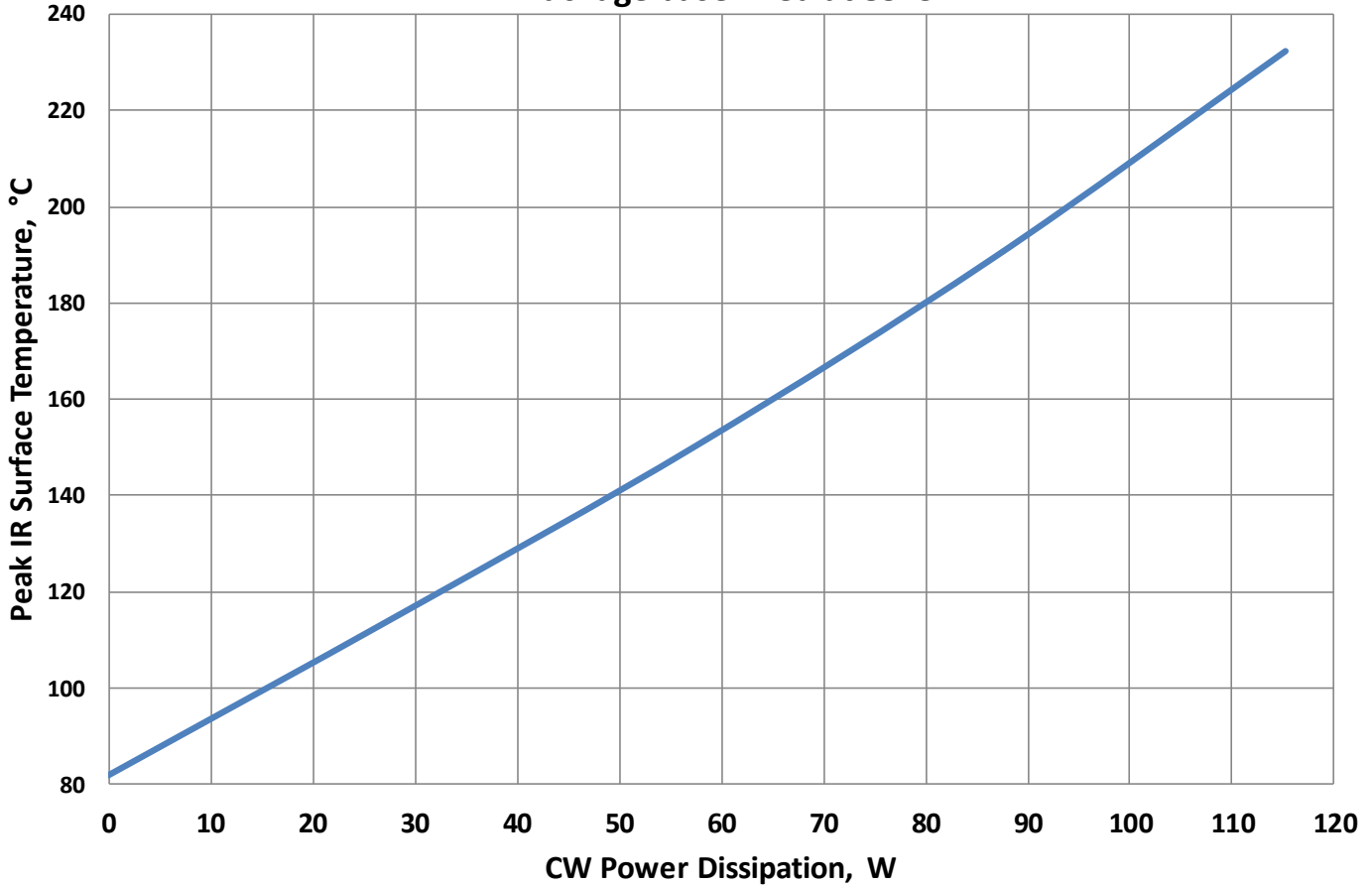
Parameter <sup>1</sup>	Conditions	Values	Units
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	0.73	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	100 W Pdiss, 1 mS PW, 5% DC	158	°C
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	0.75	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	100 W Pdiss, 1 mS PW, 10% DC	160	°C
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	0.78	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	100 W Pdiss, 1 mS PW, 20% DC	163	°C
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	0.88	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	100 W Pdiss, 1 mS PW, 25% DC	173	°C

<sup>1</sup>Refer to the following document [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

**Thermal and Reliability Information – CW**

**Peak IR Surface Temperature vs. CW Power**

Package base fixed at 85°C



Parameter <sup>1</sup>	Conditions	Values	Units
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	1.08	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	28.8 W Pdiss	116	°C
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	1.15	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	57.6 W Pdiss	151	°C
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	1.20	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	86.4 W Pdiss	189	°C
Thermal Resistance, IR ( $\theta_{JC}$ )	85 °C back side temperature	1.28	°C/W
Peak IR Surface Temperature ( $T_{CH}$ )	115 W Pdiss	232	°C

<sup>1</sup>Refer to the following document [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

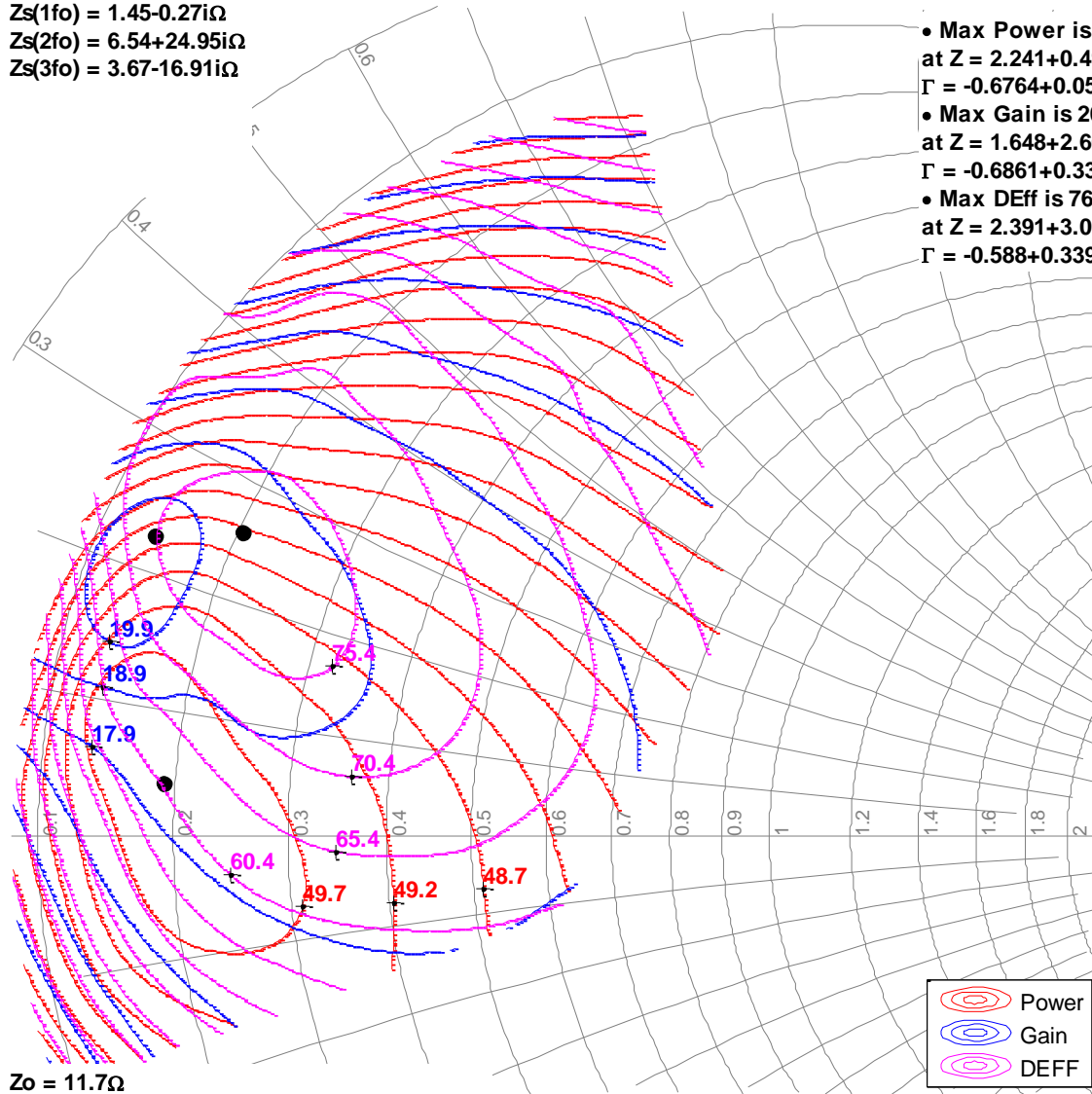
### Load-Pull Smith Charts<sup>1,2</sup>

Notes:

- $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $100\ \mu\text{S PW}$ , 20% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
- See page 15 for load-pull and source-pull reference planes.  $11.7\text{-}\Omega$  load-pull TRL fixtures are built with 20-mil RO4350B material.

### 1GHz, Load-pull

$Z_s(1fo) = 1.45 - 0.27i\ \Omega$   
 $Z_s(2fo) = 6.54 + 24.95i\ \Omega$   
 $Z_s(3fo) = 3.67 - 16.91i\ \Omega$



- Max Power is 50dBm at  $Z = 2.241 + 0.492i\ \Omega$   
 $\Gamma = -0.6764 + 0.0592i$
- Max Gain is 20.4dB at  $Z = 1.648 + 2.661i\ \Omega$   
 $\Gamma = -0.6861 + 0.3361i$
- Max DEff is 76.6% at  $Z = 2.391 + 3.013i\ \Omega$   
 $\Gamma = -0.588 + 0.3395i$

$Z_o = 11.7\ \Omega$   
 3dB Compression Referenced to Peak Gain

### Load-Pull Smith Charts<sup>1,2</sup>

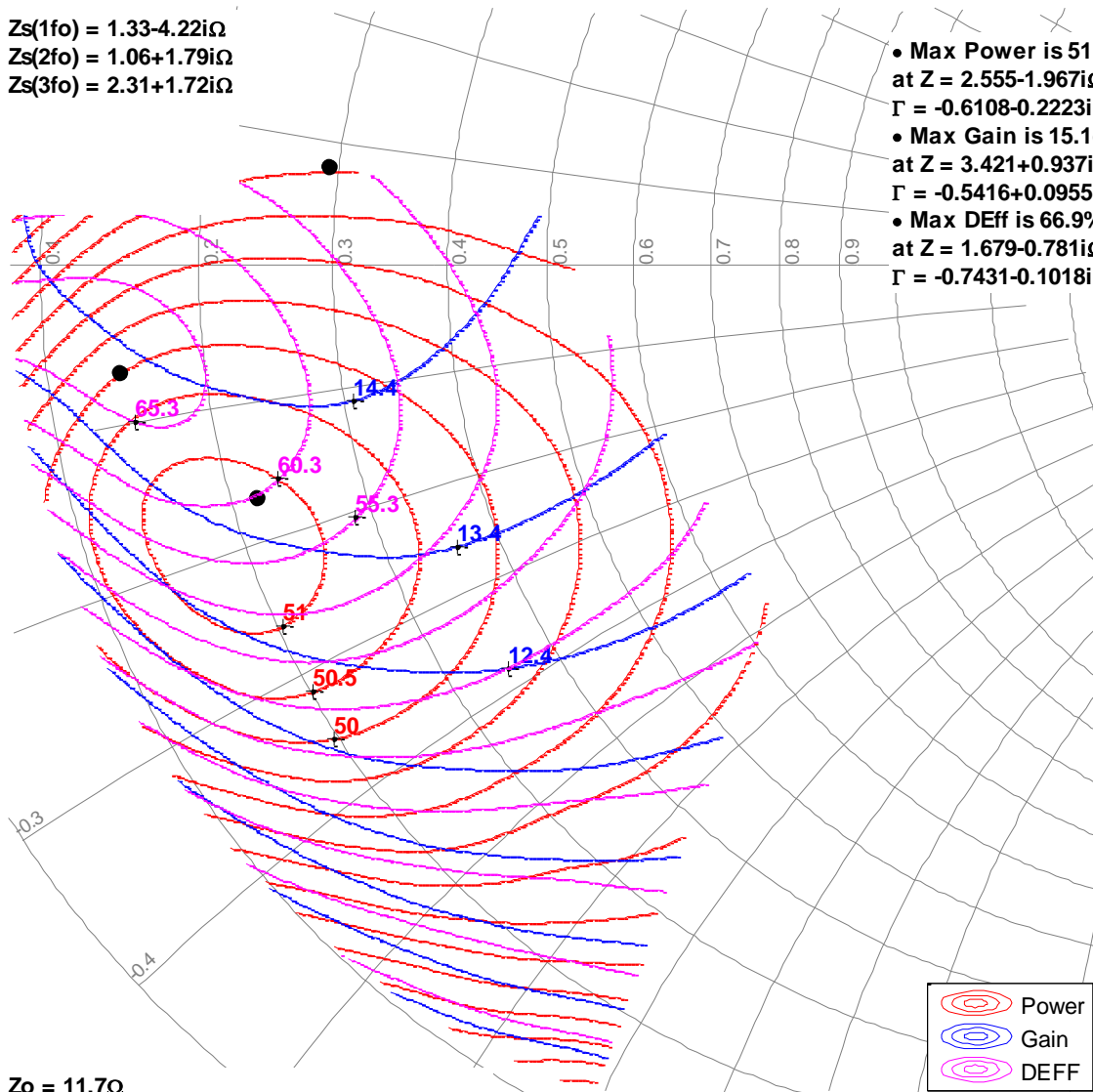
Notes:

- $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $100\ \mu\text{S PW}$ , 20% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
- See page 15 for load-pull and source-pull reference planes.  $11.7\text{-}\Omega$  load-pull TRL fixtures are built with 20-mil RO4350B material.

### 2GHz, Load-pull

$Z_s(1f_0) = 1.33-4.22i\Omega$   
 $Z_s(2f_0) = 1.06+1.79i\Omega$   
 $Z_s(3f_0) = 2.31+1.72i\Omega$

- Max Power is 51.2dBm at  $Z = 2.555-1.967i\Omega$   
 $\Gamma = -0.6108-0.2223i$
- Max Gain is 15.1dB at  $Z = 3.421+0.937i\Omega$   
 $\Gamma = -0.5416+0.0955i$
- Max DEff is 66.9% at  $Z = 1.679-0.781i\Omega$   
 $\Gamma = -0.7431-0.1018i$



$Z_0 = 11.7\Omega$   
 3dB Compression Referenced to Peak Gain



### Load-Pull Smith Charts<sup>1, 2</sup>

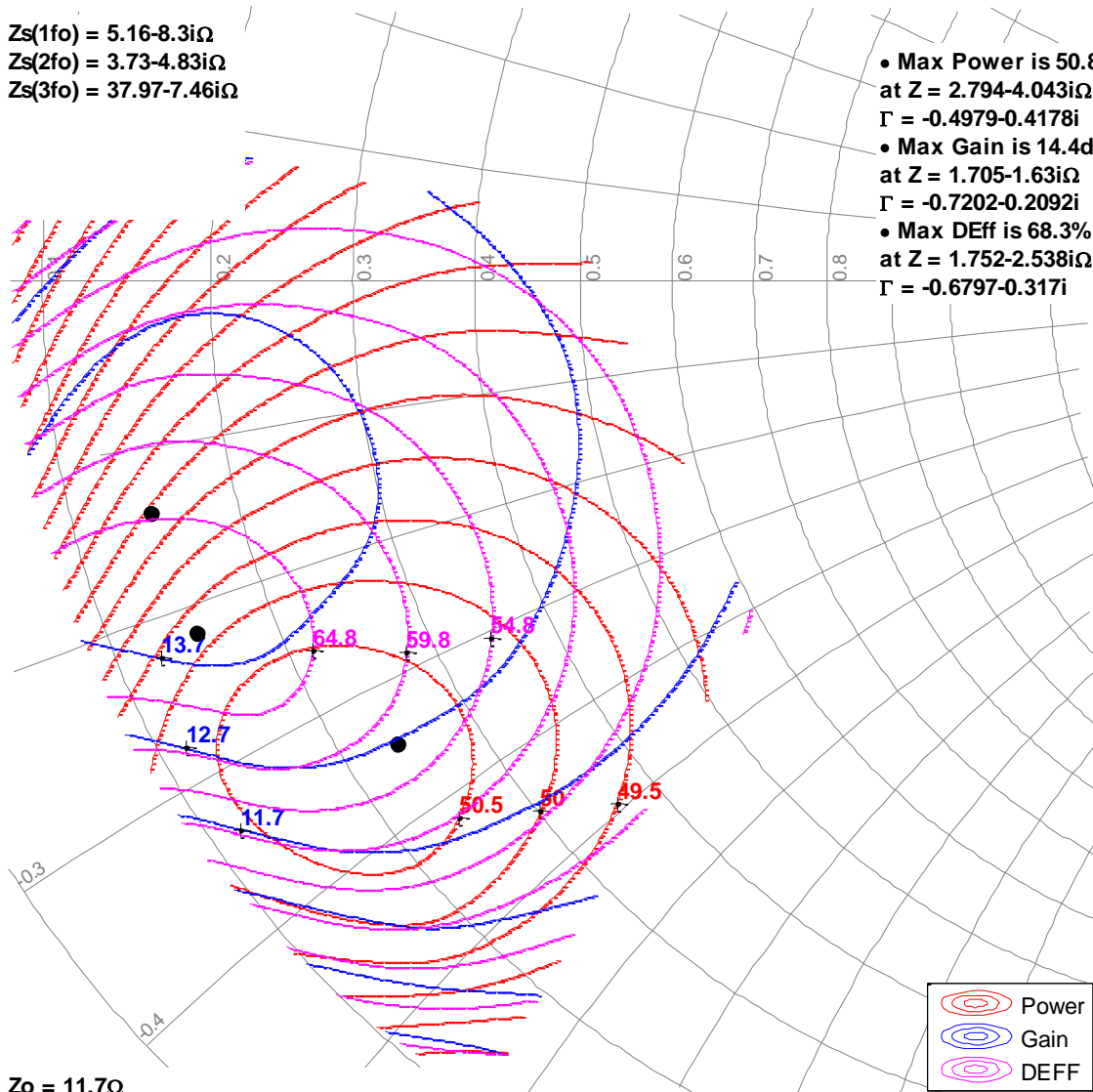
Notes:

- $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $100\ \mu\text{S PW}$ , 20% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
- See page 15 for load-pull and source-pull reference planes.  $11.7\text{-}\Omega$  load-pull TRL fixtures are built with 20-mil RO4350B material.

### 3GHz, Load-pull

$Z_s(1fo) = 5.16-8.3i\Omega$   
 $Z_s(2fo) = 3.73-4.83i\Omega$   
 $Z_s(3fo) = 37.97-7.46i\Omega$

- Max Power is 50.8dBm at  $Z = 2.794-4.043i\Omega$   
 $\Gamma = -0.4979-0.4178i$
- Max Gain is 14.4dB at  $Z = 1.705-1.63i\Omega$   
 $\Gamma = -0.7202-0.2092i$
- Max DEff is 68.3% at  $Z = 1.752-2.538i\Omega$   
 $\Gamma = -0.6797-0.317i$



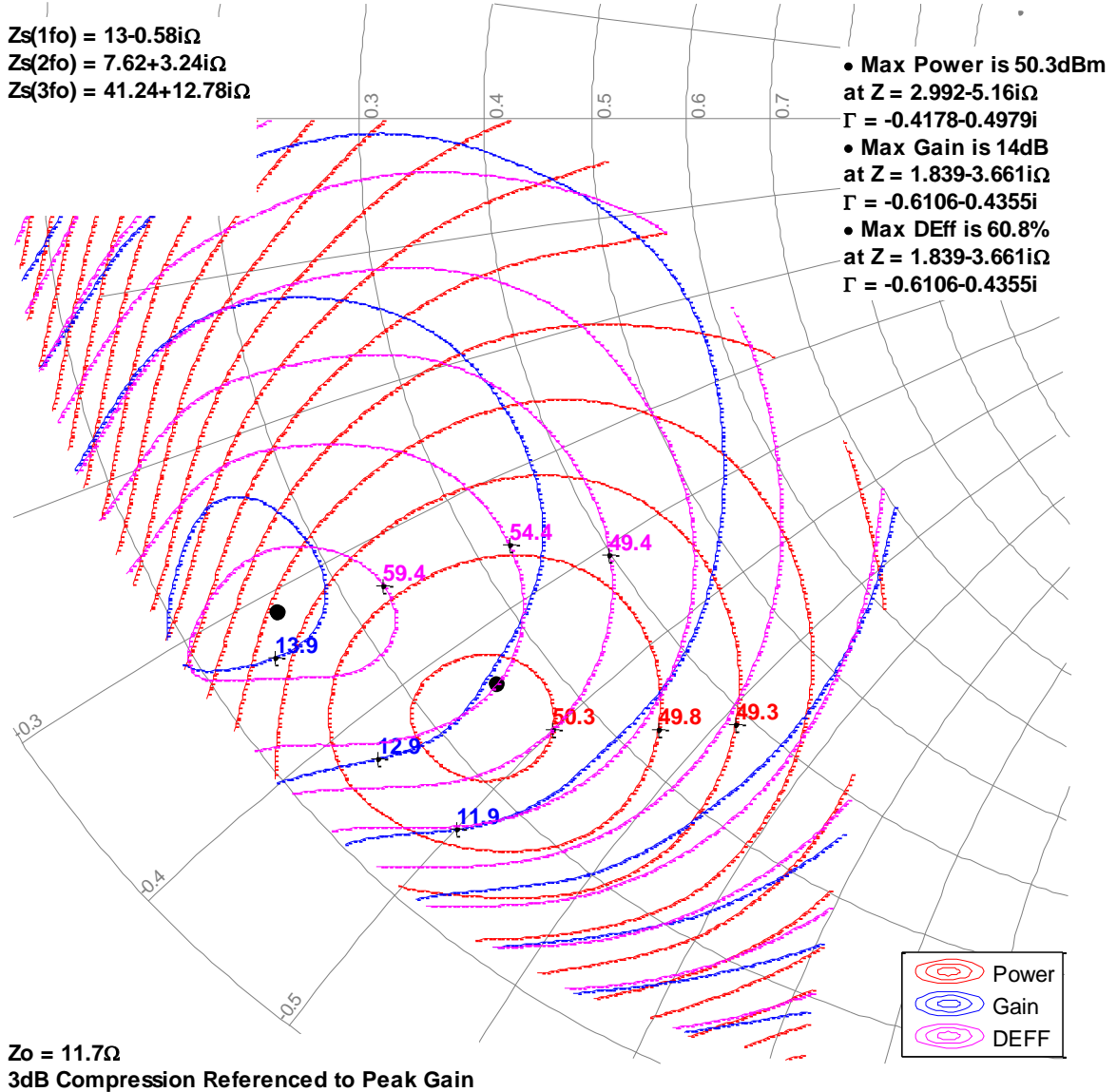
$Z_o = 11.7\Omega$   
 3dB Compression Referenced to Peak Gain

### Load-Pull Smith Charts<sup>1, 2</sup>

Notes:

3.  $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $100\ \mu\text{S PW}$ , 20% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
4. See page 15 for load-pull and source-pull reference planes.  $11.7\text{-}\Omega$  load-pull TRL fixtures are built with 20-mil RO4350B material.

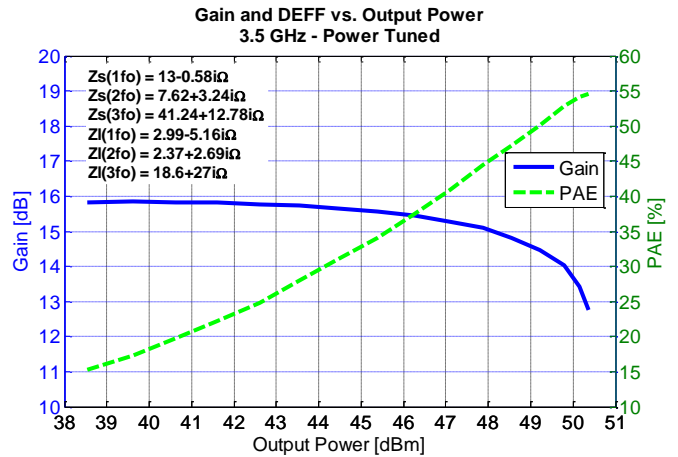
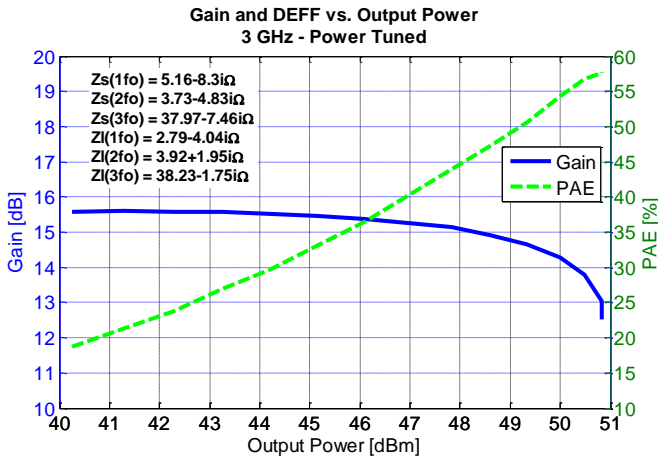
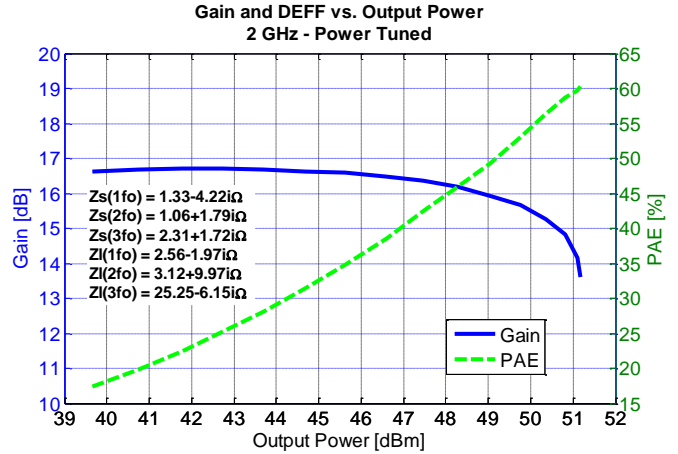
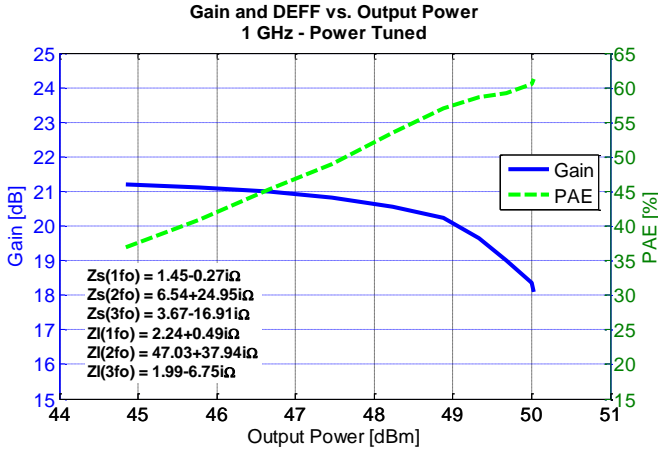
### 3.5GHz, Load-pull



### Typical Performance – Load-Pull Drive-up<sup>1, 2</sup>

Notes:

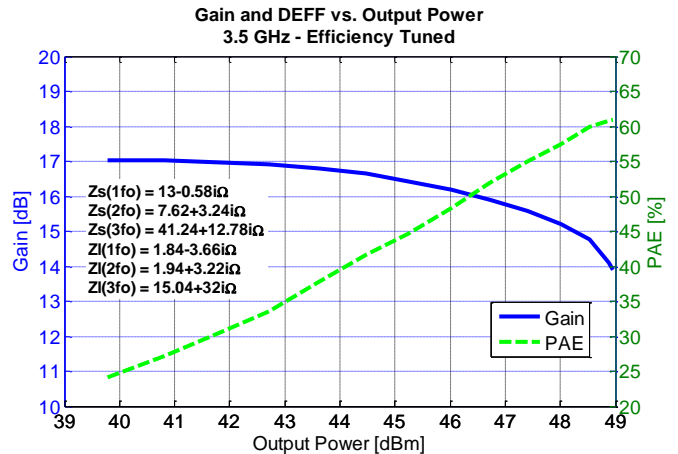
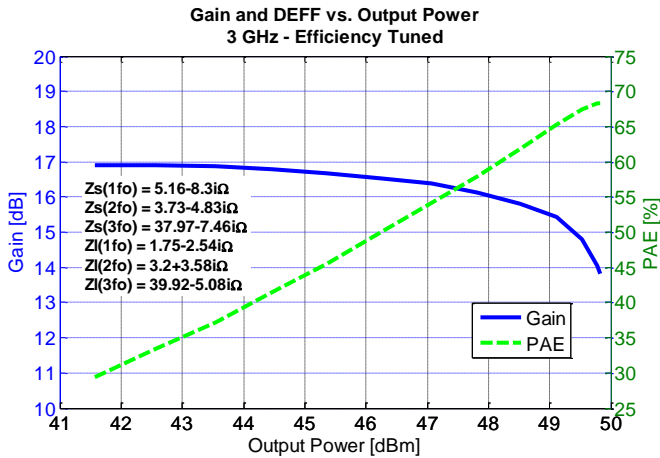
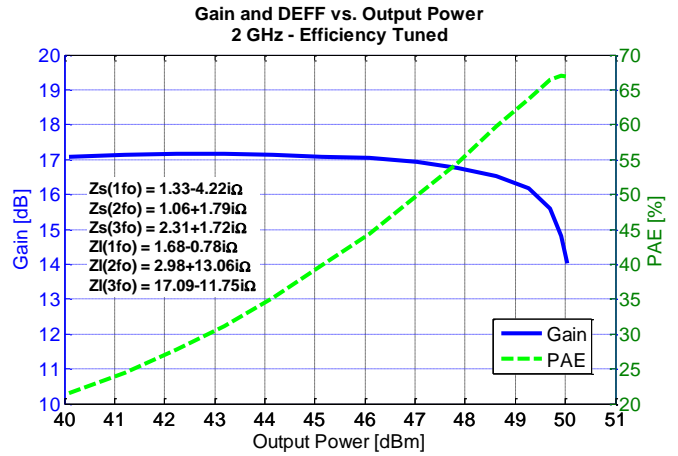
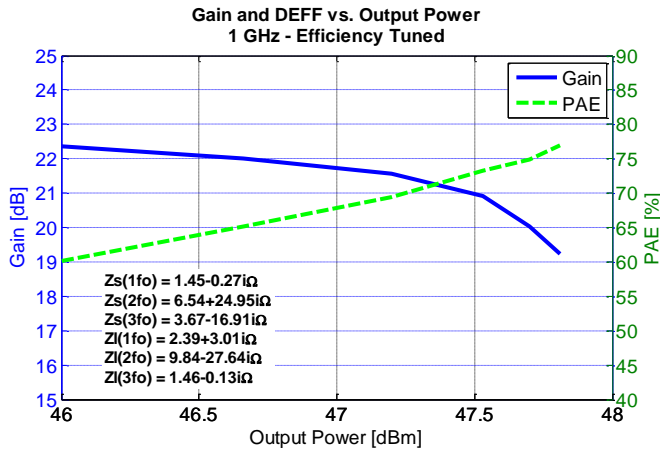
1. 100  $\mu$ S PW, 20% DC pulsed signal,  $V_D = 28$  V,  $I_{DQ} = 260$  mA
2. See page 15 for load-pull and source-pull reference planes where the performance was measured.



### Typical Performance – Load-Pull Drive-up<sup>1, 2</sup>

Notes:

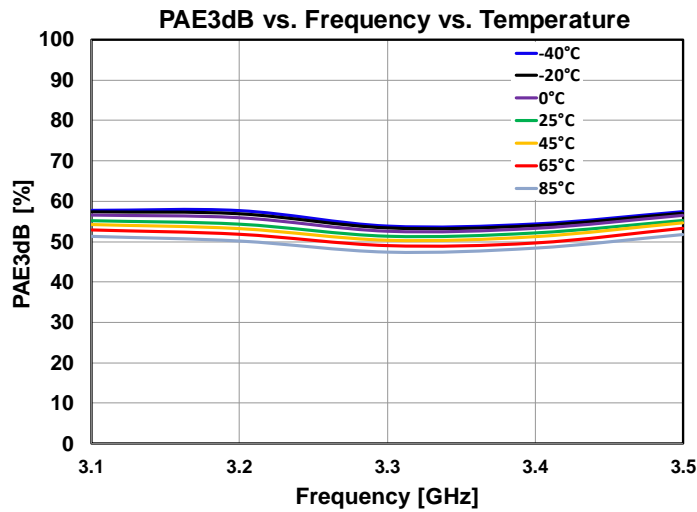
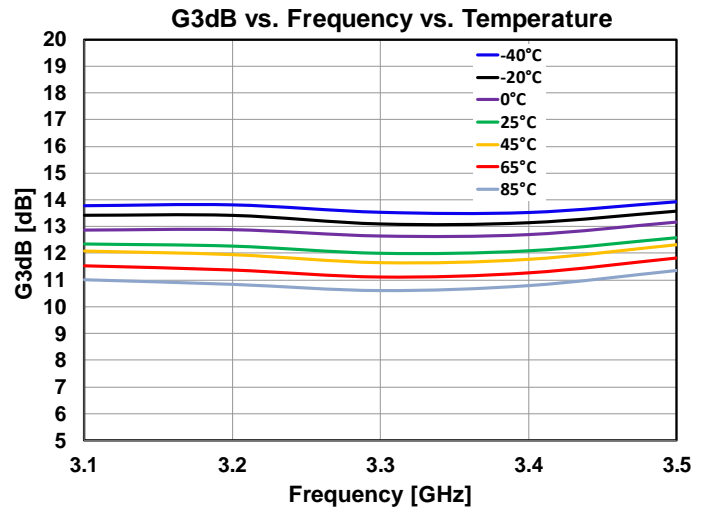
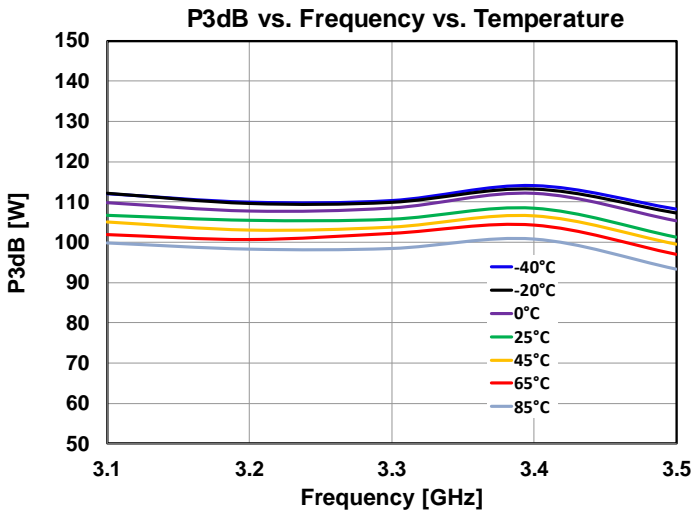
- 100  $\mu$ S PW, 20% DC pulsed signal,  $V_D = 28$  V,  $I_{DQ} = 260$  mA
- See page 15 for load-pull and source-pull reference planes where the performance was measured.



### Power Drive-up Performance Over Temperatures Of 3.1 – 3.5 GHz EVB<sup>1</sup>

Notes:

1.  $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $100\ \mu\text{S PW}$ , 20% DC

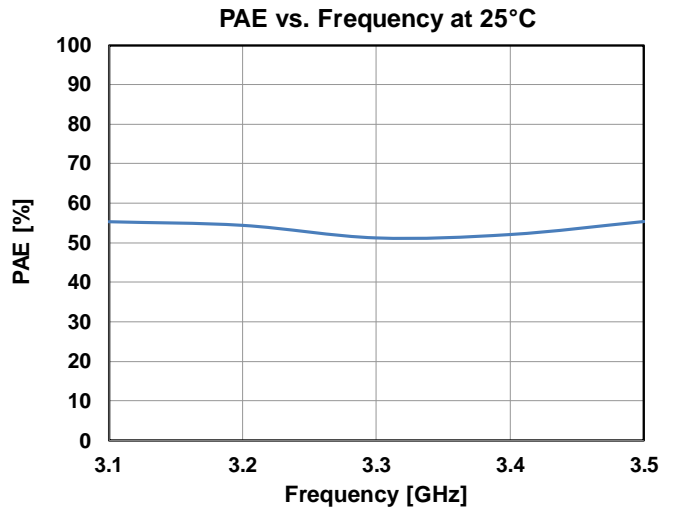
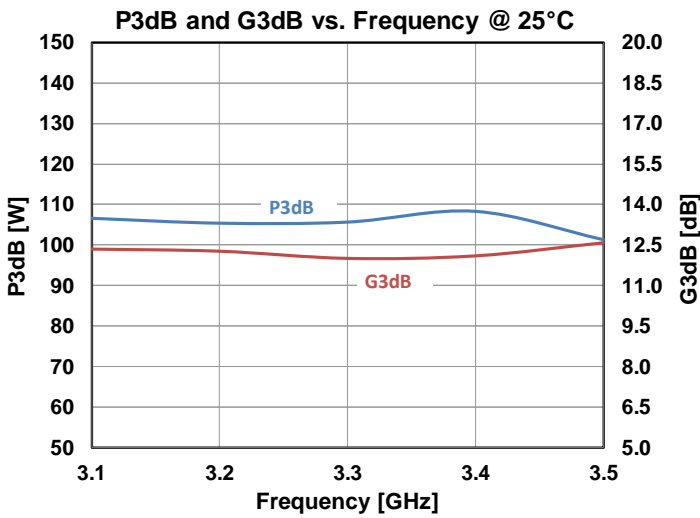




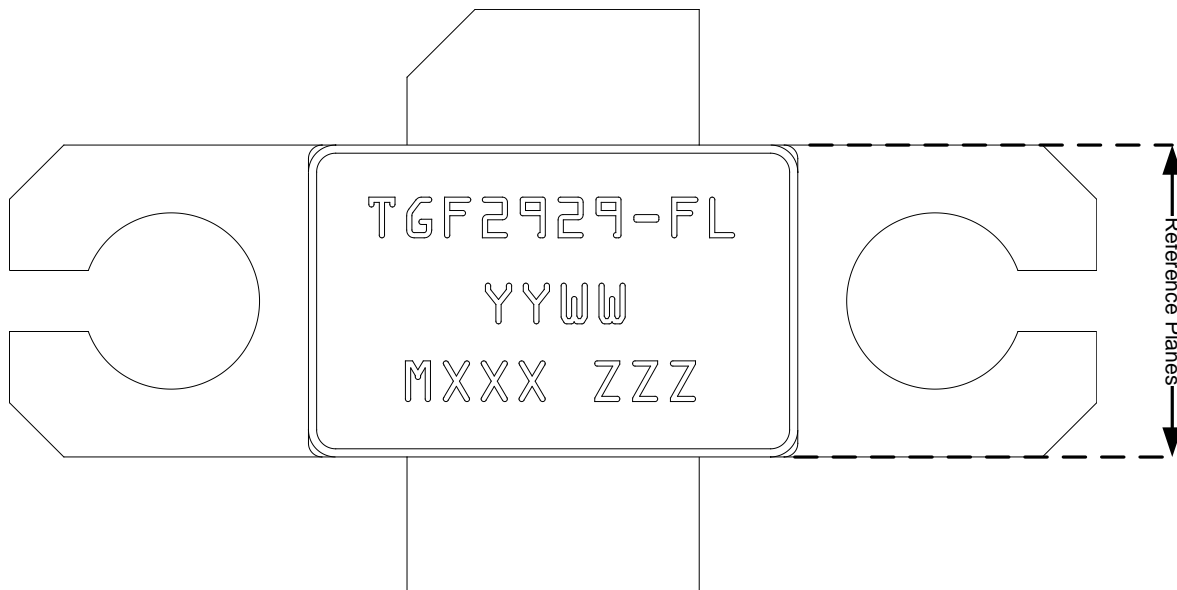
### Power Drive-up Performance At 25 °C Of 3.1 – 3.5 GHz EVB<sup>1</sup>

Notes:

1.  $V_D = 28\text{ V}$ ,  $I_{DQ} = 260\text{ mA}$ ,  $100\text{ }\mu\text{S PW}$ , 20% DC



## Pin Configuration and Description, and Package Marking<sup>1</sup>



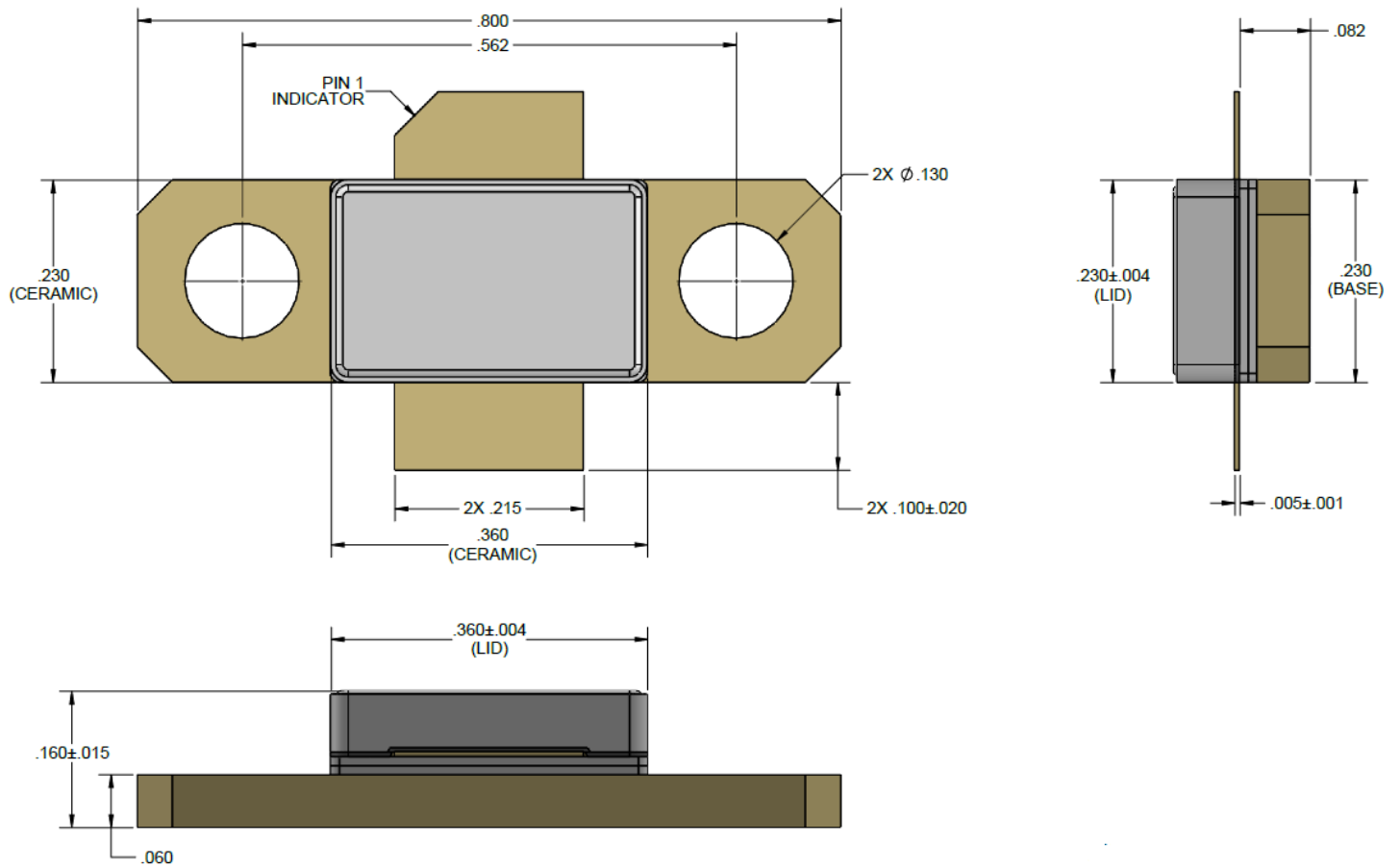
### Notes:

1. The TGF2929-FL will be marked with the “TGF2929-FL” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the calendar year the part was manufactured, the “WW” is the work week of the assembly lot start, the “MXXX” is the production lot number, and the “ZZZ” is an auto-generated serial number represents the last three digits of the calendar year the part was manufactured, the “WW” is the work week of the assembly lot start, the “MXXX” is the production lot number.

## Pin Description

Pin	Symbol	Description
1	$V_D$ / RF OUT	Drain voltage / RF Output
2	$V_G$ / RF IN	Gate voltage / RF Input
3	Base	Source connected to ground

## Package Dimensions<sup>1, 2, 3, 4</sup>

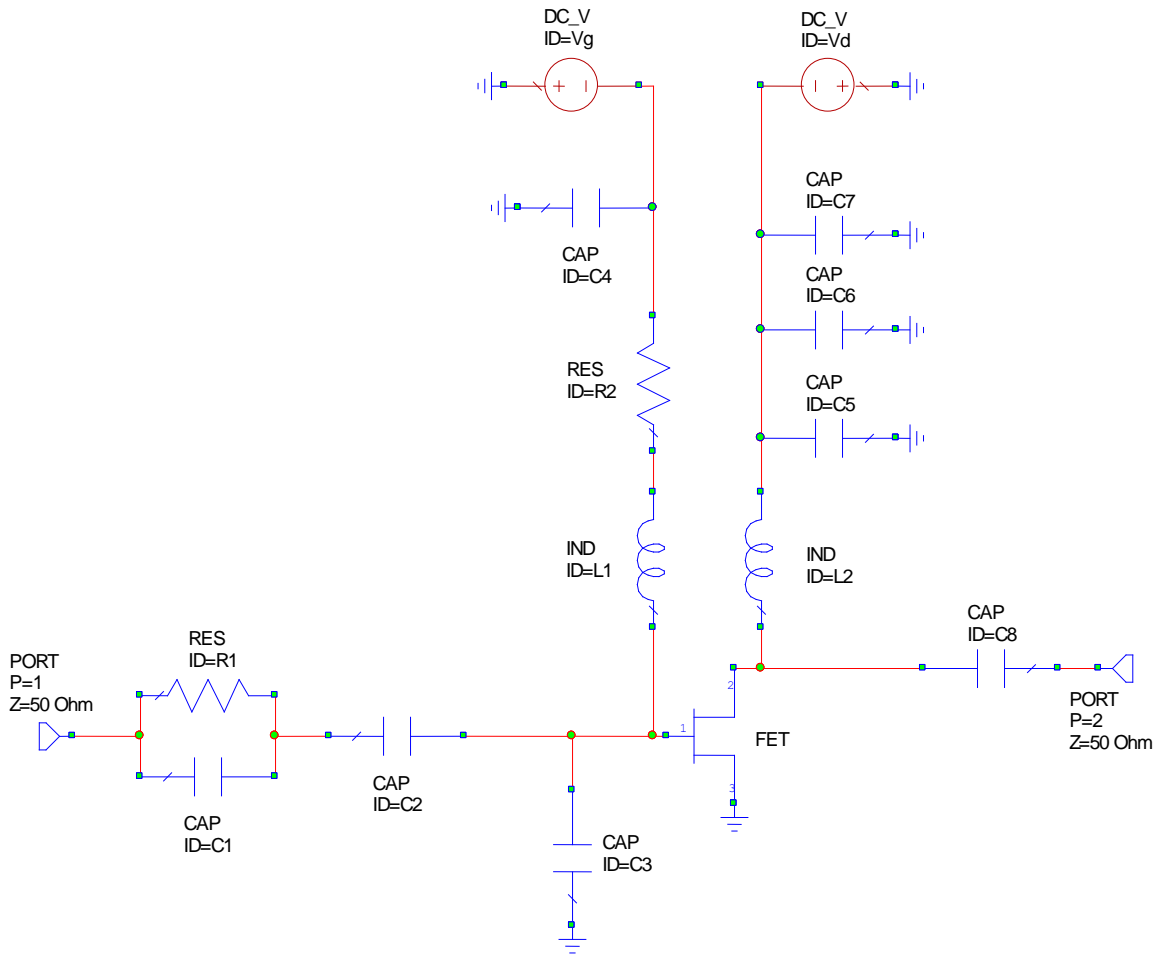


### Notes:

1. Unless otherwise noted, the tolerance is  $\pm 0.005$  inch.
2. Package metal base and leads are gold plated.
3. Part is epoxy sealed.
4. Part meets Industry NI360 footprint.



### Schematic – 3.1 – 3.5 GHz EVB



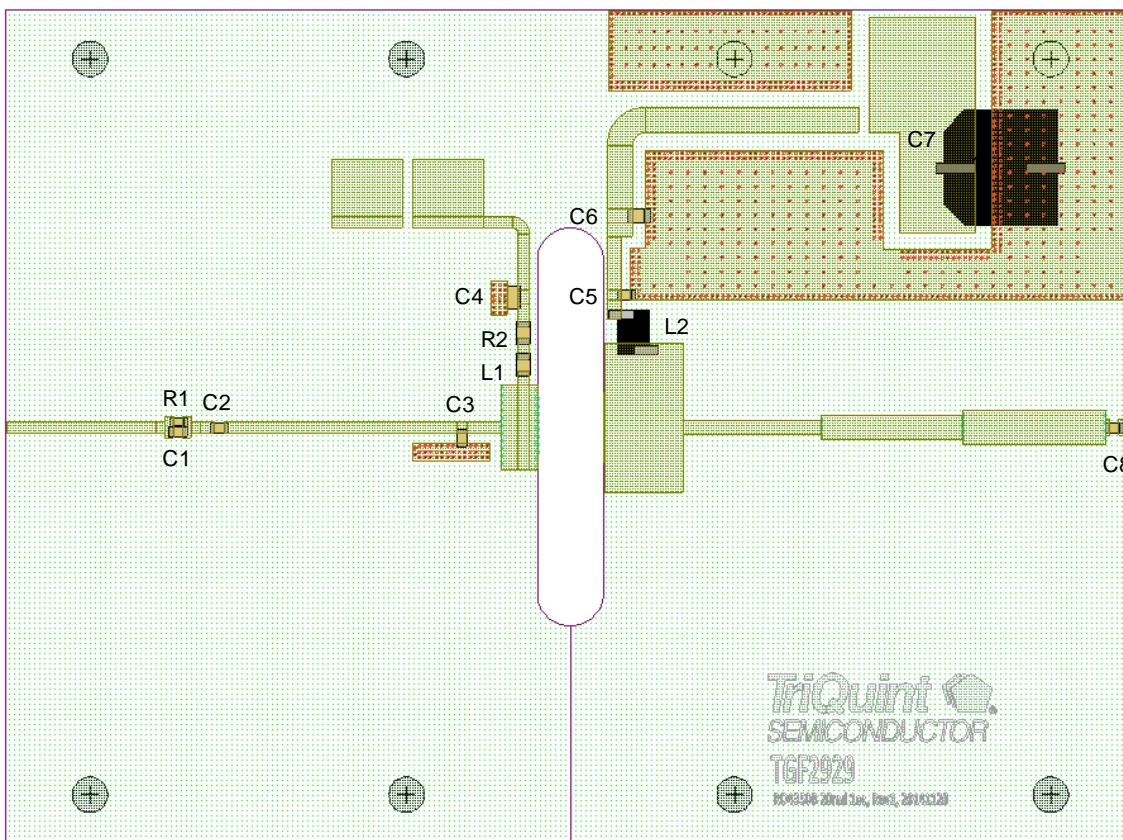
#### Bias-up Procedure

1. Set  $V_G$  to -4 V.
2. Set  $I_D$  current limit to 300 mA.
3. Apply 28 V  $V_D$ .
4. Slowly adjust  $V_G$  until  $I_D$  is set to 260 mA.
5. Set  $I_D$  current limit to 2 A
6. Apply RF.

#### Bias-down Procedure

1. Turn off RF signal.
2. Turn off  $V_D$
3. Wait 2 seconds to allow drain capacitor to discharge
4. Turn off  $V_G$

## 3.1 – 3.5 GHz EVB<sup>1</sup>



Notes:

1. PCB Material: RO4350B, 20 mil thickness, 1 oz copper cladding

## Bill of material – 3.1 – 3.5 GHz EVB

Ref Des	Value	Qty	Manufacturer	Part Number
R1	100 $\Omega$	1	Vishay/Dale	CRCW0603100RJNEA
C1, C2	5.6 pF	2	ATC	600S5R6BT
C3	1.0 pF	1	ATC	600S1R0BT
L1	22 nH	1	Coilcraft	0805CS-220X-LB
R2	10 $\Omega$	1	Vishay/Dale	CRCW060310R0JNEA
C4	10 $\mu$ F	1	Murata	C1632X5R0J106M130AC
L2	12 nH	1	Coilcraft	A04T_L
C5	2400 pF	1	Murata	C08BL242X-5UN-X0T
C6	1000 pF	1	ATC	800B102JT50XT
C7	220 $\mu$ F	1	United Chemi-Con	EMVY500ADA221MJA0G
C8	15 pF	1	ATC	600S150JT250XT

## Recommended Solder Temperature Profile

